Space Weather Technical Forecast

Issued on Thursday, 29 February 2024 at 00:32 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Ongoing risk of M or X flares from AR3590 in the northwest.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Activity has been Moderate during the last 24 hours with a long period M-flare, reaching M1.5 at 28/1854 UTC from AR3590. This remains the largest and most significant potential flare source. The magnetic structure of the group remains relatively simple, with the spot aligned E-W and only limited mixing of polarities. However, the large delta spot persists within its intermediate spots. This spot also has a large amount of associated flux, increasing the potential for larger flares, should any occur. The other regions are smaller, however AR3595 has seen ongoing growth with latitudinal spread, becoming a more mature bipolar spot. AR3596 and AR3597 are both much smaller, but have a N-S aligned magnetic structure which could increase instability.
Three CMEs of note were observed in the last 24 hours. One from a filament eruption from the southeast of the disk around 28/0909 UTC and the other towards the northeast, although with an uncertain source. Both have been analysed as largely missing Earth, although some glancing influence cannot be completely ruled out. A further CME from AR3590 associated with the long period M-flare is yet to be analysed, awaiting imagery.

Solar Wind / Geomagnetic Activity: Solar winds as recorded by ACE and DSCOVR at L1, showed a minor enhancement - perhaps some limited influence from CH03/-. Wind speeds were mostly slightly elevated, varying between 380-460 km/s. Density was average or below. Interplanetary magnetic field, Bt, was weak throughout, below 6nT. The north-south component, Bz, varied weakly between +4/-5nT, and was mainly southward directed. Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background levels with the associated 24 hour fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 29/0000UTC was 1.48e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Low to Moderate activity is expected with isolated M-class flares. There remains a slight chance of X-class flares from AR3590.

Solar Wind / Geomagnetic Activity: There are three recent CMEs which are all most likely to miss Earth, but with a risk of some glancing influence, most likely on Day 3 (02 Mar), perhaps extending into Day 4 (03 Mar). Solar winds have become slightly elevated once again, likely due to some weak interaction with the high speed stream from CH03/-. No further notable enhancements are expected with any other coronal holes on the disc too far south to influence Earth.
Geomagnetic activity is forecast to be mostly Quiet, but perhaps increasing to Unsettled to

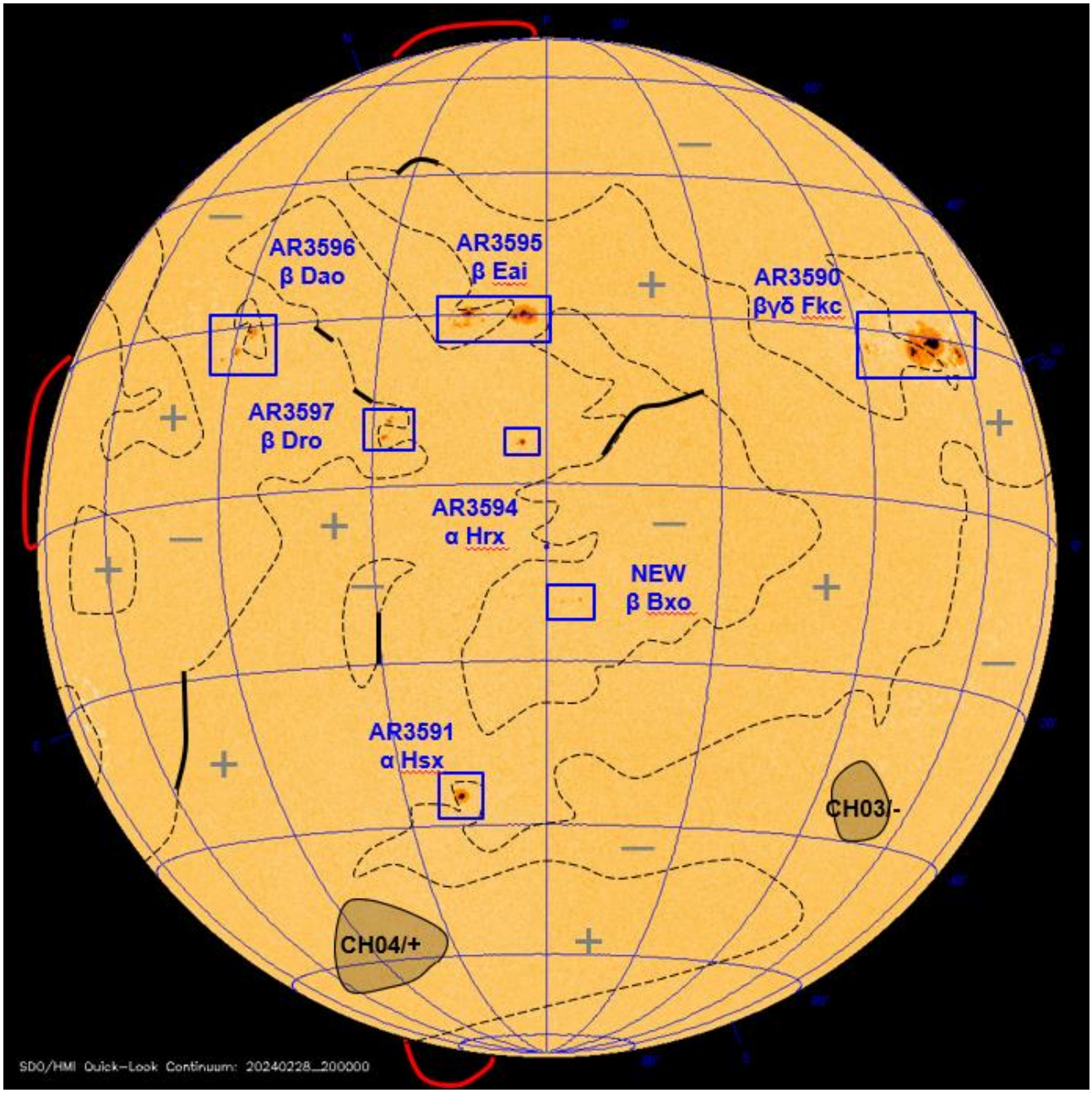
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Active with any CME influence on Days 3 and 4.

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is likely to stay at background levels, but with a slight chance of rising above S1 in response to any notable flares from AR3590, due to its position in the western disc. GOES16 high energy electron flux is expected to remain at background levels with the associated 24 hr fluence remaining well below the Active threshold throughout.

Figure 1. Solar Analysis Valid 28/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Met Office Space Weather Technical Forecast

Geomagnetic Storms:

There are three recent CMEs which have been considered for any Earth directed influence - one from 27 Feb and two from 28 Feb. All are thought most likely to miss Earth, but with a risk of some glancing influence, most likely on Day 3 (02 Mar), perhaps extending into Day 4 (03 Mar).

Solar winds have become slightly elevated once again, likely due to some weak interaction with the high speed stream from CH03/-. No further notable enhancements are expected with any other coronal holes on the disc thought unlikely to influence Earth.

Geomagnetic activity is forecast to be mostly Quiet, but perhaps increasing to Unsettled to Active with any CME influence on Days 3 and 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

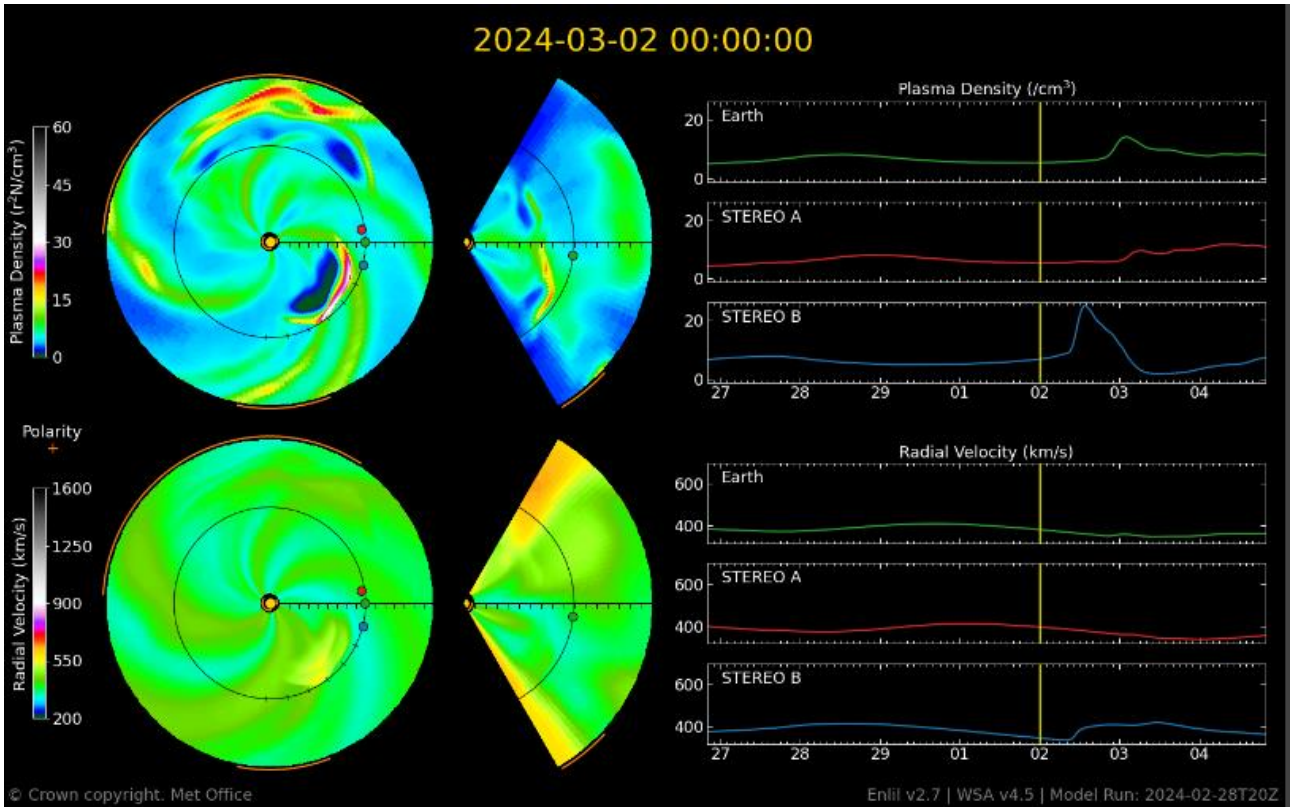
Geomagnetic Activity - Earthbound Coronal Mass Ejections

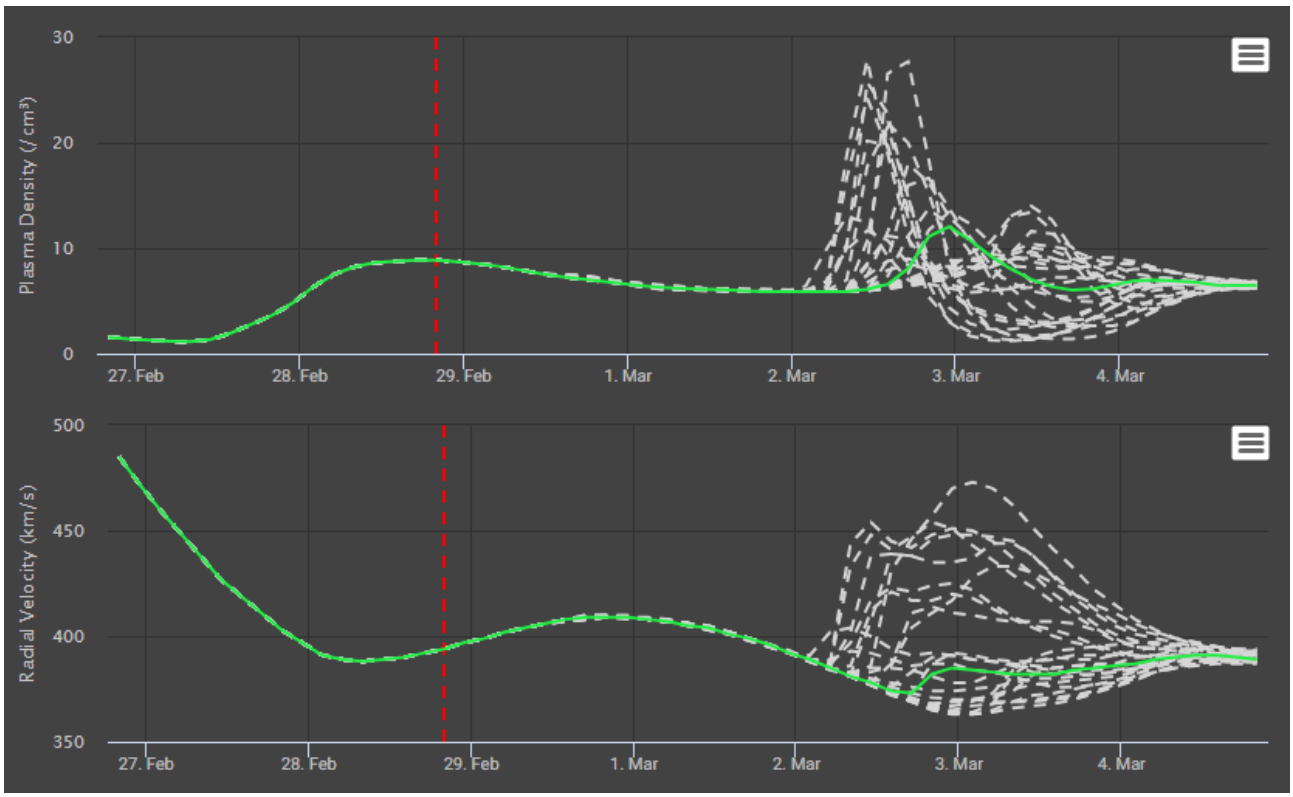
Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
27/1856	Partial	Filament	South centre	450 km/s	02/2100 UTC	Glancing blow possible
28/1335	Partial	Filament	Southeast	750 km/s	02/1200 UTC	Glancing blow possible
28/1743	Partial	Uncertain	Northeast	460 km/s	02/1800 UTC	Glancing blow possible

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOC Enlil showing potential CME glancing blow(s) on 02-03 March. Otherwise, background or slightly elevated wind speeds expected.





Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

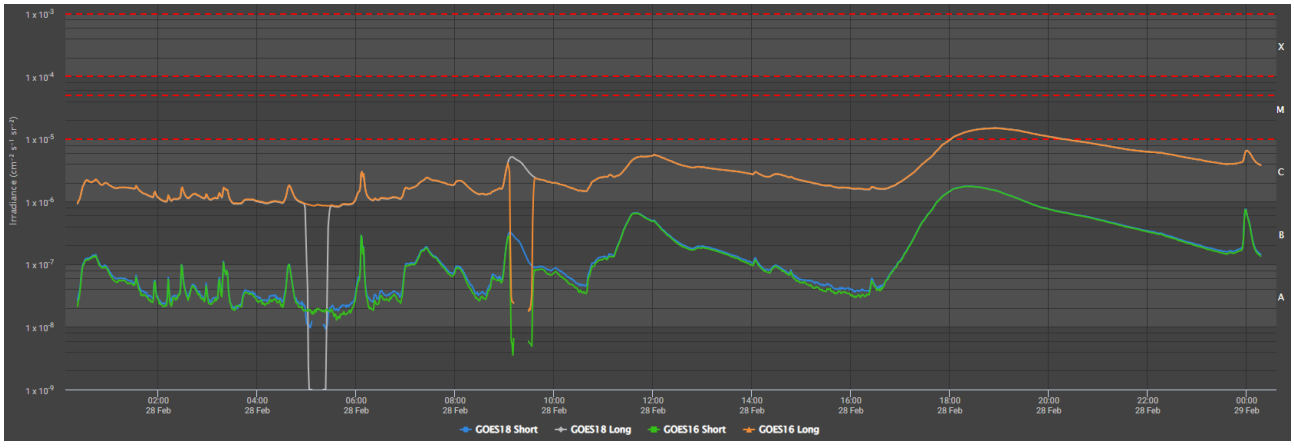
Radio Blackouts - X-Ray Flares:
Activity has been Moderate during the last 24 hours with a long period M-flare, reaching M1.5 at 28/1854 UTC from AR3590.

There are seven sunspot regions on the disc, with AR3592 now faded. AR3590 remains the largest and most significant potential flare source. The magnetic structure of the group remains relatively simple, with the spot aligned E-W and only limited mixing of polarities. However, the large delta spot persists within its intermediate spots. This spot also has a large amount of associated flux, increasing the potential for larger flares, should any occur. The other regions are smaller, however AR3595 has seen ongoing growth with latitudinal spread, becoming a more mature bipolar spot. AR3596 and AR3597 are both much smaller, but have a N-S aligned magnetic structure which could increase instability.

Isolated M-class flares are considered likely, with a slight chance of X-class flares. The strongest flares are most likely to be from AR3590. AR3590 will rotate off the disc late on Day 3 (02 Mar), with the risk of flares declining through Day 4 (03 Mar) as it rotates away from the limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	60	60	50
Very Active	R3 to R5 X Class	No	20	20	20	15

Figure 3: X-ray flux at GOES16 and 18, showing the long period M-flare from AR3590.



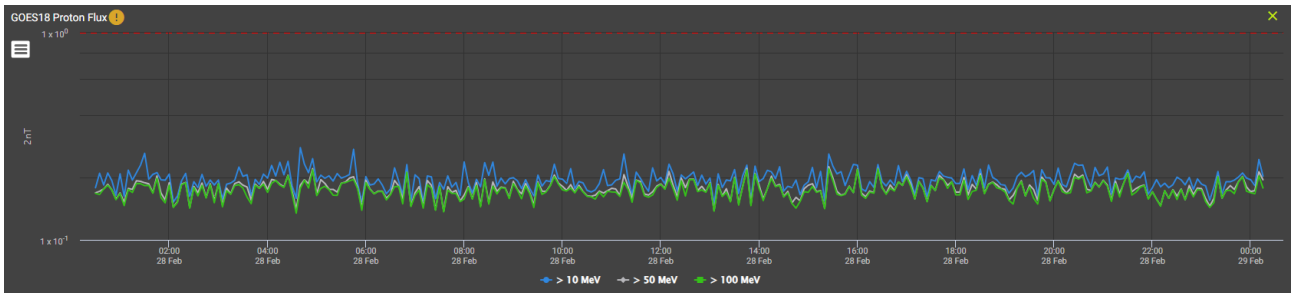
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
GOES-18 proton flux is currently at background levels, and is likely to remain so through this period. However, there is a slight chance of enhancement as AR3590 moves across the western disc, with this region now in a prime location for any large flares to also result in an observable proton enhancement at Earth. This is low confidence however, due to the current relatively low activity from the region, and relatively simple configuration despite its size and the presence of a large delta spot. Although AR3590 rotates off the disc late on Day 3 (02 Mar), the risk of proton events remains until it is well over the west limb, by around a further 3 days.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	15
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux at GOES18, which is currently at background levels.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

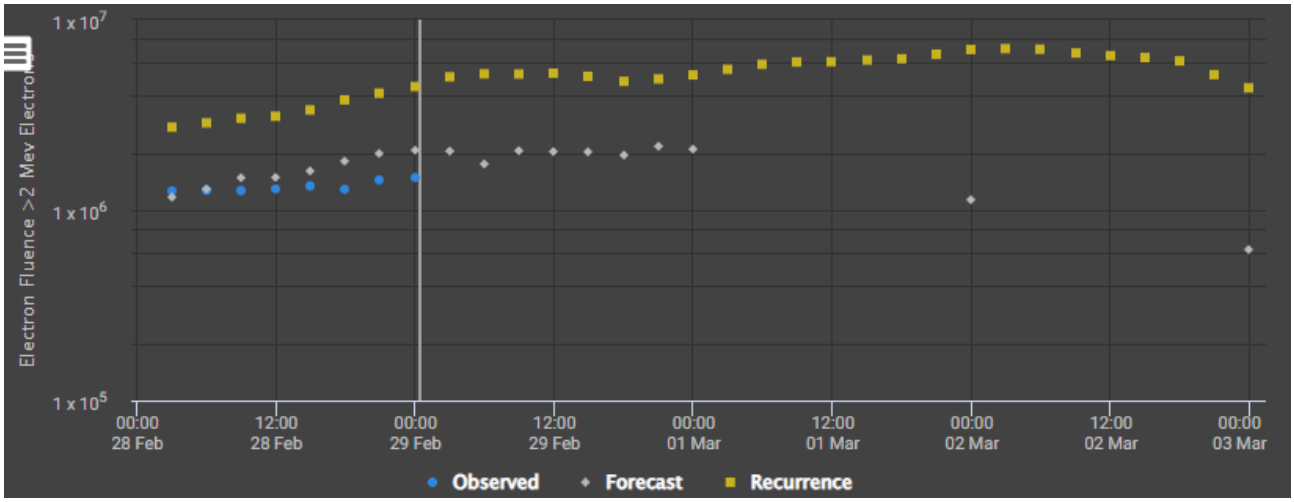
© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at background levels. Recent fast wind enhancement from CH01/- and potential current minor enhancement from CH03/- are both relatively weak affairs, despite the observed G1/Minor Storm on 27 Feb, and the GOES-16 electron flux is expected to persist at background levels. No further notable enhancements are forecast.

The associated 24 hour fluence is expected to stay well below the Active (1e8 integrated pfu) threshold, with REFM currently giving good guidance to expected conditions.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM, which is forecast a well below Active trend through the next three days.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.